But Why: A Podcast for Curious Kids

How are records made?

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Jane 00:20
This is But Why: A Podcast for Curious Kids from Vermont Public. I'm Jane Lindholm. On this show, we take questions from curious kids just like you, and we find answers. Do you like listening to music? Most people do. But when you want to hear music, what kind of technology do you use? Some folks have smart speakers in their home, and they just say, "Hey, smart speaker, could you please play my favorite song? Thank you!" Or maybe your adults help you play music on their phone, or they pop a CD into a CD player, or turn on the radio in your home or car. Or maybe they pull out a big vinyl record and put it on a turntable. Thomas Edison was the person who first figured out how to capture record sound and play it back later. He did this by creating a device called the phonograph in 1877. Ten years later, Emile Berliner built on that invention to make the gramophone. Unlike the earlier phonograph, which used circular tubes or cylinders to hold recordings, the gramophone used flat discs, much more like what we're familiar with now, that made it much easier to make lots of recordings--to mass produce them--and so the record was created. Records became a popular way to listen to music around the middle of the 20th century. So that means in the mid 1900s. For a long time, they were the main way people were able to buy their own music and listen back whenever they wanted. Some of your parents and probably your grandparents grew up listening to records. While new technology like cassette tapes, CDs and now digital recording devices have been invented, records never really went away (unlike the cassette tape) and for the last few decades, they've been making a strong comeback. So we aren't surprised that you've sent us some questions about this important technology. We wanted to go to a place where records are made to get some answers to your questions. And an opportunity presented itself when I was recently visiting Austin, Texas, a city known for its colorful music scene. Do you think of it that way, that you are making music?

Caren Kelleher 02:37
I'm Caren Kelleher. I'm the founder and CEO of Gold Rush Vinyl, one of the few record pressing plants in the United States, about 8600 square feet, and this is where we physically make records that people buy. We have four pressing machines. Since opening, we've done over a million records. I have one of the coolest jobs in the world, because I get to make music for a living, but not performing it, just making it so other people can listen to it and share it. Yeah, I'm a kind of a record producer, in a sense. But one of the best parts about my job is that every single day is different. We get to listen to new music coming out and help put it into a physical form so people can hold it, can read about the album and have it for as long as they're collecting records.

Jane 03:25
Caren and I were standing in the doorway of her company's building as we talked. It's basically one huge open room with lots of loud machinery, big bags of different colored plastic and boxes and boxes

of records. Before we got into how records get played, I wanted to understand how they get made. Can you show me around Gold Rush Vinyl and I'll ask you some of the questions that kids have sent us while we're getting the tour?

Caren Kelleher 03:52
Very happy to. Let's go for a walk.

Jane 03:54
Okay.

Mabel 03:54
Hi. My name is Mabel. I'm seven years old. I live in Tampa, Florida, and my question is, how were vinyl records made?

Caren Kelleher 04:06
Right now we're walking through our plastic area. So vinyl records are made with something called PVC, polyvinyl chloride. It looks like beads of plastic, which is really fun. And they come in different colors, so the beads of plastic are what we're going to put into our machines. We're going to melt that plastic down into something that looks almost like a hockey puck or a biscuit, and then our machines are going to physically press the grooves of a record into the plastic. We heat it, cool it, kind of like a waffle maker is a good way to think about it. And after about 30 seconds, that melted plastic becomes a vinyl record you can put on your turntable.

Jane 04:42
If you've never seen a record, or held one, it kind of looks like a very flat frisbee or a flat plastic plate. The most common size of a record is 12 inches in diameter, so a foot across. But the record starts as just a bunch of tiny plastic pellets. The specific type of plastic, vinyl, is also used in flooring or pipes. If you've ever heard of PVC pipes, those are vinyl. It's even used to make shower curtains, umbrellas and rain coats. Vinyl became popular for making records more than 75 years ago, and it's still what is usually used to make them today. So a record starts out with these tiny vinyl pellets, and they used to always be black, but at Gold Rush, they're different. One of the cool things that I'm noticing is that you have all kinds of colors of these little plastic pellets. So you can make records in all kinds of colors, not just black.

Caren Kelleher 05:42
Any colors. And in fact, that's now majority of what we do is specialty mixes. And it really fun for our team; they can come up with new names for the colors. Today, we're pressing one that's kind of like a tie dye, yellow and blue. Last week, they came up with one called berries and cream, another one called mermaid that has like a shimmer to it. And so it's really fun when musicians come to us and say, can you make our record? We can work with them to make their own colors.

Jane 06:07
Can we see the pellets being put in?

Caren Kelleher 06:09
We're gonna get up close to our machines. These are called pressing machines, and they are very dangerous. Our operators are trained in them because they use a ton of pressure to flatten out the plastic. So we're gonna go, get up close, and maybe Robbie, our press operator, will tell us what he's doing.

Jane 06:24
And I won't put my fingers anywhere near it.

Caren Kelleher 06:25
No, don't. It's a very easy way to lose a finger. Those are very precious.

Jane 06:29
I walked closer to the pressing machine, and I could see that on one side of it, the press operator was taking cupfuls of these colored vinyl pellets and pouring them down a big funnel that went into the machine. There were dark blue and light blue pellets, bright orangey pellets and sparkly purple ones. He was pouring them in a very specific order.

Robbie Carroll 06:50
My name is Robbie. Robbie Carroll. Right now I'm doing what's called a hand pour, one color after another in a sequence that the customer or we determine, and yeah, the results are a little bit more dramatic on the final end. My favorite color is easily green.

Jane 07:07
But you don't have any green in this record!

Robbie Carroll 07:09
Well, the good news is blue and yellow kind of make green.

Jane 07:13
What's the name of this color that you're creating for the record?

Robbie Carroll 07:15
Boy, I actually don't know if we have a name for this one.

Caren Kelleher 07:19
Can we ask the kids, maybe, to take a look at it and give us their ideas?

Jane 07:24
I love that idea. So we have a picture of the record Robbie was making. You can find it on the episode page for this episode at butwhykids.org It's also on our Instagram page. You can have an adult help you navigate the internet to see it. Tell us what you think this special record color should be named. You can tell us in the comments on our social media or write to questions@butwhykids.org with your name for this record color.

Callie 07:53
Hi. My name is Callie. I live in San Antonio, Texas. I'm seven years old. My question is, how do recorded things like videos and songs work? Thank you.

Finley 08:06
Hello. I'm Finley. I'm nine years old, and I live in Minnesota. And my question is, how does music get put onto a record?

Maya 08:15
Hi, my name is Maya. I'm eight years old. I live in South Orange, New Jersey. And my question is, how do people get songs into records?

Jane 08:27
The way I wrap my head around this is to start by thinking about it this way: in order to make a record, you have to take a sound and turn it into something physical that you can hold. And then when you play it, you're turning that physical thing back into something you can hear. Let's start with sound. Sound travels through the air as a wave of vibrating air molecules. You can't see it, but your ears turn those vibrations into electrical signals that your brain can interpret. A waveform is the graph of how the sound moves. When you make a recording, you're capturing that sound wave and turning it into an electrical signal, and then capturing that electrical signal so it can be recreated again and again. Sound was first recorded by dragging a vibrating needle through wax to draw the waveform. Then you could play back that recording on the wax cylinder that you had drawn the waveform into. Once you have a recording of that live sound, you want to be able to reproduce it, so everyone can have their own record of the same music. To do that, these days, instead of using wax, a master disc is made out of enamel coated metal. The enamel isn't as hard as the metal.

Caren Kelleher 09:48
Think kind of like sticky paste. And we use a machine that's called a lathe to cut grooves into the records. So we carve through that enamel. That gives us what's called the master. And we then make metal plates off of that. So the metal plates are the opposite. So what was a groove on your lacquer is a peak on this metal plate. And the metal plates get put in our machines so that we can press a record over and over and over again. That's why it's called a pressing plant. So our pressing machines, what they do is we put in these metal plates. They're called stampers. And those two stampers get put in this machine, and we press the plastic into the record shape. Now these records are coming off our machine really hot. We cook them really high temperature, so we have to put them between metal plates to cool them down so that they don't end up all floppy.

Jane 10:35
So in this one machine, these vinyl pebbles get melted down into something that looks like a hockey puck, and then pressed under tons of pressure, and while they're getting pressed down into that flat disc, the shape of the music is pressed into each side of the record, and what comes out is what we call a record. Caren described it to me a little like how a waffle maker takes batter and turns it into a solid waffle with a very distinct shape.

Caren Kelleher 11:04
Now, just like I was saying with the waffle maker, there's sometimes the batter spills over. We have that happen with our records, so we trim it, and that's what's called flash. It's little ribbons of vinyl records that kind of get cut off the record before it goes into a cooling plate.

Jane 11:17
At Gold Rush, they actually use that flash to make vinyl flowers that people can buy. They're trying not to waste anything in their process. Once the record is cooled, it gets inspected to make sure it looks and plays right. Then it gets put into a protective sleeve or jacket and packaged up and shipped out.

Caren Kelleher 11:37
So as we're pressing the records, we're also testing them for sound, to make sure that the right music is on the right record, and that there aren't any skips or pops or things that can go wrong with the record. So we have a record player out on the floor that the operators use, and then one in our listening room, which is a little quieter.

Jane 11:54
Let's go in there. When we come back, we'll explore how we actually hear those grooves that have been pressed into the record.

BREAK 12:02
BREAK

Jane 12:03
I'm Jane Lindholm and today, we're learning about an old technology that revolutionized our ability to share music and sounds, and is still popular. Today, we're learning about vinyl records at Gold Rush Vinyl in Austin, Texas, with the company's CEO, Caren Kelleher. After showing me around the manufacturing area where they make the records, Caren took me into their listening room, which was much, much quieter. This is where they listen to the records they've made--not all of them, but enough to make sure the sound is good before they ship their boxes out. Karen has a couple of really cool record players in this room, and I asked her to describe how a basic record player works, because, after all, a record is made to be played, isn't it?

Caren Kelleher 12:52
You know, a lot of people who even collect records don't have record players. They're just collecting the records to have them permanently or on a shelf or something to look at. Or maybe they're saving money to buy a record player. But a record player has a couple key components. One is what's called the turntable. That's what makes the record spin round and round, and that's connected to a belt underneath the table that allows it to spin. We also have, obviously, the record needle, and it's connected to what's called a tone arm, and the tone arm allows the needle to kind of move across the record as we're listening. The needle is probably the most important part of the turntable, and connected to the needle is a tiny, tiny microphone that the wires run through the record player and into your speakers. The way a record works is, if you think about like a bus going by you real quick, the

whooshing sound, that's air movement, right? So a needle is going to go across the grooves of the record, and as it hits it, it's making sound, but it's very quiet sound, which is why the the tone arm and the needle are connected to a little microphone amplify that sound. So I'll even play you a record without it, without the speakers on, and you can kind of start to hear a little bit of the noise and the difference when we put a record fully on.

Jane 14:06
So you're taking a record out now.

Caren Kelleher 14:08
I'm taking it out. This is a soundtrack called Bee and Puppycat, which we really like a lot. And this is really pretty color. It's called Coke bottle. It looks like old Coca Cola glass bottles. It's kind of like a greenish, clear color. So I'm going to turn the record player on. And one thing that's interesting about records is they can spin at different speeds. So this is at 33 and 1/3 rpm, which means rotations per minute. That means it's going to go around 33 and 1/3 times in a minute. Sometimes records are cut at what's called 45 and that's faster, it's going to 45 times per minute. So I'm going to make sure that the setting is correct on this. Okay, so now the turntable is spinning, and I'm going to get ready to settle the the needle on the record. Once the music starts playing, it's because the record needle is hitting the grooves of the record and the vibrations that are happening are creating sound.

Jane 14:58
And we're going to do that first without the speaker on, so we can just hear what it actually sounds like with the needle moving on the record. I don't know if you could hear that. It sounded like somebody had music on in their headphones, and you were hearing what was leaking out of the headphones. It's so quiet, but this is what it sounds like when you put the speaker on and you can actually hear the music.

music 15:45
MUSIC

Jane 15:50
Let's recap. A record player is designed to play music or sound recordings, because the record, even though it has all of those grooves that represent the sound waves can't play itself. So you put the record on a turntable, which spins it around at a set speed, and then an arm with a needle on it is placed on the surface of the record. That needle moves through the grooves. Fun fact: the tip of that needle, also sometimes called a stylus, is usually made out of industrial diamond. That's because diamonds are really hard, so the needle can withstand being moved along grooves of records for hours and hours and hours and hours. And even though it's made out of diamond, it's a very, very tiny diamond, and not the sparkly one you might see on jewelry, so it doesn't cost as much as you might think to replace it. Anyway, that needle moves along the grooves of the record, and the vibrations of the needle are picked up by a cartridge that converts those vibrations into an electrical signal. That electrical signal then gets boosted by an amplifier and sent out through speakers, which actually convert those electrical signals back into sound waves that go to your ears, and then your ears convert them back to electrical signals to send to your brain, which then interprets those electrical signals as

beautiful music! I don't know about you, but my brain feels like it's going to explode with how complicated this all is. How in the world did people manage to come up with this technology? It's amazing. I told Caren Kelleher that I feel like I just barely understand how this all works.

Caren Kelleher 17:33
I make them for a living, and I don't even really understand how it works. It's a little bit of magic, honestly. But that's, I think, what makes vinyl so special is that it's, it's really bizarre that somebody figured out how to put music into a piece of wax and now plastic.

Jane 17:50
What's also cool is when you look at a record, they all look kind of the same. I mean, maybe different colors, but they look kind of the same. You can't, you can see that there are ridges, but you can't see that there's music on there. They just look like a record with ridges.

Caren Kelleher 18:05
If we took a microscope to this, and this is what we do when we make the master, you can see it almost looks like like a canyon. So when music has what's called heavy bass, it's really deep, you know, like a bass drum or a cello or something like that, the grooves will be really deep. It'll look like a really deep canyon. And when it's quiet, it'll be really shallow. So almost, if you're if we were to to shrink ourselves down and put ourselves in the groove of a record and go through it, it's almost like, yeah, going through a cavern, or with crazy mountains around it and a river. It's just very bizarre that this is how it works. But again, when that needle hits the sides of the grooves, is how the sound is manipulated.

Jane 18:46
It's really cool to visualize it that way, because there are things called sound waves, but when you put them on a record, it almost looks like a landscape. So you're seeing the different ways different music sounds is like the difference between a landscape with just a couple of hills, or a really sort of mostly flat landscape, versus a landscape that's really mountainous and big ups and downs, and the music is different, so the landscape is different.

Caren Kelleher 19:10
That's exactly right. You can come work here.

Jane 19:14
That would actually be really fun. I think I'd want to do the job Robbie was doing over on the manufacturing floor, choosing the different colored vinyl pellets to create an amazing-looking record. But at Gold Rush, it's more than just making a physical record that's important to them.

Caren Kelleher 19:30
Here at Gold Rush, we work with artists that are trying to make a living from their music, but might not have the big backing of a huge record label, and so they'll come to us and ask us to really help guide their careers a little bit so that they can make some money to keep making art. We've become known now for a lot of the crazy colors that you heard us describing out on the floor, as well as real 24-karat

gold records that you can kind of see on studio walls and things like that. We have a machine that's even crazier than the one that presses the records that can turn a record into gold.

Jane 20:04
How much does a record like that cost?

Caren Kelleher 20:06
If it's framed, it's very expensive. It can cost $500 or more. But the normal records we make for artists typically will cost them maybe $5 to make.

Jane 20:17
So a place like Gold Rush is partly special because you might have an artist who's not famous and doesn't need a million records made, but they might need 500 records made, and you can do that for them so that they can afford to have records that they can sell at shows and to fans.

Caren Kelleher 20:33
That's exactly what we do here, and especially because with the way musicians are paid for their music, you might have to have 2 million people watch a YouTube video to make the same money that if you sold 100 vinyl records. So you don't have to have as many fans, but some that really want to own your music to make a big impact in your career, and that money helps the musicians drive to the next tour stop or put the next album out, or just to feed their families.

Jane 20:59
What did you think you wanted to be when you were a kid?

Caren Kelleher 21:01
When I was a kid, I wanted to be a, you know, like, own a record label. I loved, there was a TV show when I was growing up called Jem and the Holograms

Jane 21:09
Ugh, I loved that show.

Caren Kelleher 21:10
And it was all about the music industry. And I was more concerned, like, how does Jem get to the top of the charts and also be a good person as a musician and use her influence? And so I've always wanted to be in the music industry, but I didn't have any talent myself, really for music as much as I tried to practice. So this has been a good place for me to be in the music industry without having to be on stage.

Jane 21:31
So even as a kid, you were what we might call an entrepreneur or a business person. You had a business person's mind.

Caren Kelleher 21:37

I did. And you know what? I had parents that were really encouraging of me. I used to have some really crazy ideas for things I wanted to start. And rather than say that's silly or you can't do that, my parents would say, Huh, why don't you spend an afternoon writing out what you would do, come up with what we call a business plan, or draw the restaurant you want to open. And I think their encouragement of that creativity and letting me explore things led me down a path where I felt safe to open a factory like this.

Jane 22:04
Caren, I feel like you're dangerously close to telling us that it really is important to learn math and to pay attention in school.

Caren Kelleher 22:11
It is. I was really good in school, but you know what? Nobody challenged me to think about engineering and chemistry, and now I have to deal with that a lot in this job, and I'm really good at it as it turns out, but I also get to work with musicians to come up with the names of their records. And, you know, I loved painting in school. And every time we make a new record and come up with new color, it's like, it's just like being an art class again. So pay attention to school. Then you have all kinds of opportunities like this to do things that are even different than your dreams.

Jane 22:40
Thanks to Caren Kelleher, the CEO and founder of Gold Rush Vinyl in Austin, Texas, for showing us around her factory and helping us understand the mind blowing science and technology behind records and record players. We've got pictures and videos on our social media pages and our website if you want to see more of what this all looks like. And while you're over on our website, your adults can sign up for our newsletter. We send one out every time there's a new episode. And if you like our show, we'd love it if you and your adults would write us a review or tell a friend about But Why. If you have a question for us, you can always have an adult help you record it and send it to questions@butwhykids.org We love hearing what you're interested in knowing about. Our show is produced by Sarah Baik, Melody, Bodette and me, Jane Lindholm, at Vermont Public. We are distributed by PRX. Our But Why Bites series producer over on YouTube is Joey Palumbo, and our theme music is by Luke Reynolds. We'll be back in two weeks with an all new episode. Until then, stay curious.